

CLAIMS

1. A method of advancing a mole to define a passageway through a composition between first and second locations spaced from each other a substantial first distance, the method comprising the steps of:

attaching the mole to a cable;
providing a support;
providing a cable pulling assembly on the support; and
operating the cable pulling assembly to cause a pulling force on the cable to be continuously applied through the cable pulling assembly to the cable and therethrough to the mole to thereby cause the mole to be advanced in a path a substantial second distance at least partially over the first distance between the first and second locations.

2. The method of advancing a mole to define a passageway according to claim 1 wherein the step of operating the cable pulling assembly comprises operating the cable pulling assembly to cause the pulling force on the cable to be continuously applied as the mole is advanced over the entire first distance between the first and second locations.

3. The method of advancing a mole to define a passageway
2 according to claim 1 wherein the step of providing a cable pulling assembly
comprises providing a cable pulling assembly comprising a drive, a gear
4 assembly, and a capstan assembly, the drive operable to operate the gear
assembly to cause at least a part of the capstan assembly to be driven around
6 a first axis so as to cause the cable to be engaged and pulled by the part of the
capstan assembly as the part of the capstan assembly is driven around the first
8 axis.

4. The method of advancing a mole to define a passageway
2 according to claim 3 wherein the step of providing a gear assembly comprises
providing a gear assembly comprising a sun gear that is driven by the drive and
4 at least one planet gear that is drivingly engaged between the sun gear and the
part of the capstan assembly.

5. The method of advancing a mole to define a passageway
2 according to claim 1 wherein the step of providing a support comprises
providing a support that acts between the composition and the cable pulling
4 assembly and that transfers to the composition a reaction force generated by
the cable pulling assembly as the cable pulling assembly is operated.

6. The method of advancing a mole to define a passageway
2 according to claim 5 wherein the step of providing a support comprises
providing a support comprising a reaction plate with an enlarged, substantially
4 flat surface, that is borne against the composition at the second location.

7. The method of advancing a mole to define a passageway
2 according to claim 6 wherein the step of providing a support comprises
providing a support comprising a frame to which the cable pulling assembly is
4 releasably attached and a reaction cage acting between the frame and the
reaction plate.

8. The method of advancing a mole to define a passageway
2 according to claim 1 further comprising the step of releasably attaching the
cable pulling assembly to the support in an operative position by relatively
4 repositioning the cable pulling assembly and support without requiring use of
any separate fasteners to maintain the cable pulling assembly attached to the
6 support in the operative position.

-42-

9. The method of advancing a mole to define a passageway
2 according to claim 1 further comprising the step of causing operation of the
cable pulling assembly to be automatically stopped as an incident of the mole
4 being advanced to a predetermined position relative to the cable pulling
assembly.

10. The method of advancing a mole to define a passageway
2 according to claim 1 further comprising the step of causing a conduit to follow
movement of the mole from the first location to the second location whereby a
4 continuous passageway is defined by the conduit between the first and second
locations.

11. The method of advancing a mole to define a passageway
2 according to claim 1 wherein the step of providing a cable pulling assembly
comprises providing a cable pulling assembly comprising a capstan assembly
4 comprising an annular cable-engaging part and a drive that is operable to move
the cable-engaging part around a first axis so that the cable is engaged by the
6 cable-engaging part and pulled as the cable-engaging part is moved around
the first axis.

-43-

12. The method of advancing a mole to define a passageway
2 according to claim 11 further comprising the step of locally exerting a radial
force on the cable as the drive is operated to urge the cable toward the cable-
4 engaging part of the capstan assembly.

13. The method of advancing a mole to define a passageway
2 according to claim 11 further comprising the step of bearing the cable against
the cable-engaging part of the capstan assembly through in excess of 180°
4 around the first axis.

14. The method of advancing a mole to define a passageway
2 according to claim 11 further comprising the step of bearing the cable against
the cable-engaging part of the capstan assembly through on the order of 270°
4 around the first axis.

15. An apparatus for defining a passageway through a
2 composition between first and second spaced locations, the apparatus
comprising:
4 a cable pulling assembly; and
a support for the cable pulling assembly,

6 the cable pulling assembly operable by a drive that is operable to
cause a pulling force on a cable to be continuously applied so that a mole
8 attached to a cable can be moved under a force continuously applied to the
cable through a composition between first and second spaced locations.

16. The apparatus for defining a passageway through a
2 composition between first and second spaced locations according to claim 15
further in combination with a cable and a mole attached to the cable.

17. The apparatus for defining a passageway through a
2 composition between first and second spaced locations according to claim 15
wherein the cable pulling assembly comprises a capstan assembly with an
4 annular cable-engaging part and a gear assembly operatively engaged
between the drive and the cable-engaging part to cause the cable-engaging
6 part to be driven around a first axis.

18. The apparatus for defining a passageway through a
2 composition between first and second spaced locations according to claim 17
wherein the gear assembly comprises a sun gear that is driven by the drive

4 around the first axis and at least one planet gear that is drivingly engaged
between the sun gear and the cable-engaging part of the capstan assembly.

19. The apparatus for defining a passageway through a
2 composition between first and second spaced locations according to claim 18
wherein the gear assembly comprises a plurality of planet gears each drivingly
4 engaged between the sun gear and the cable-engaging part of the capstan
assembly.

20. The apparatus for defining a passageway through a
2 composition between first and second spaced locations according to claim 15
wherein the support comprises a reaction plate with an enlarged, substantially
4 flat surface that can be borne against a composition to transfer a reaction force
generated by the cable pulling assembly to a composition, through which a
6 passageway is being formed, as the cable pulling assembly is operated.

21. The apparatus for defining a passageway through a
2 composition between first and second spaced locations according to claim 20
wherein the support further comprises a frame to which the cable pulling

-46-

4 assembly is attached and a reaction cage acting between the frame and the
reaction plate.

22. The apparatus for defining a passageway through a
2 composition between first and second spaced locations according to claim 21
wherein the cable pulling assembly is releasably attached to the frame in an
4 operative position.

23. The apparatus for defining a passageway through a
2 composition between first and second spaced locations according to claim 22
wherein the cable pulling assembly is releasably attached to the frame by
4 relatively repositioning the cable pulling assembly and frame, and the cable
pulling assembly can be changed from a position fully separated from the
6 frame into the operative position and maintained in the operative position
without requiring any separate fasteners.

24. The apparatus for defining a passageway through a
2 composition between first and second spaced locations according to claim 23
wherein there are a cooperating projection and receptacle, one each on the
4 cable pulling assembly and frame, the projection defining a pivot axis, and the

-47-

6 cable pulling assembly is changeable from a pre-assembly position into the
operative position by pivoting movement of the cable pulling assembly around
the pivot axis.

25. The apparatus for defining a passageway through a
2 composition between first and second spaced locations according to claim 24
wherein the receptacle is U-shaped and opens upwardly.

26. The apparatus for defining a passageway through a
2 composition between first and second spaced locations according to claim 25
wherein there is a graspable handle on the cable pulling assembly that can be
4 grasped and repositioned to facilitate repositioning of the cable pulling
assembly relative to the frame.

27. The apparatus for defining a passageway through a
2 composition between first and second spaced locations according to claim 25
wherein the cable pulling assembly further comprises a bearing element
4 spaced from the pivot axis and with the cable pulling assembly in the operative
position the bearing element abuts to the support to transfer a reaction force

-48-

6 generated by the cable pulling assembly to the support as the cable pulling
assembly is operated.

28. The apparatus for defining a passageway through a
2 composition between first and second spaced locations according to claim 27
wherein the projection is on the cable pulling assembly and abuts to the
4 support simultaneously as the bearing element abuts to the support with the
cable pulling assembly in the operative position so that the bearing element
6 and projection cooperatively transfer the reaction force generated by the cable
pulling assembly to the support as the cable pulling assembly is operated.

29. The apparatus for defining a passageway through a
2 composition between first and second spaced locations according to claim 28
wherein the support has a U-shaped receptacle bounded by an edge to which
4 the bearing element abuts.

30. The apparatus for defining a passageway through a
2 composition between first and second spaced locations according to claim 15
wherein the cable pulling assembly comprises a capstan assembly with an

4 annular cable-engaging part that is driven around a first axis to cause a pulling
force to be exerted by the cable-engaging part on a cable.

31. The apparatus for defining a passageway through a
2 composition between first and second spaced locations according to claim 30
wherein the cable pulling assembly is repositionable relative to the support and
4 further comprising a cable tensioning assembly on the support for locally
exerting a radial force on a cable engaged by the cable-engaging portion.

32. The apparatus for defining a passageway through a
2 composition between first and second spaced locations according to claim 16
further in combination with a conduit with an internal passageway that is
4 engaged by the mole to follow movement of the mole as the mole is moved
through the cable pulling assembly.

33. The apparatus for defining a passageway through a
2 composition between first and second spaced locations according to claim 21
wherein the reaction cage is releasably connected to each of the reaction plate
4 and the frame.

-50-

34. The apparatus for defining a passageway through a composition between first and second spaced locations according to claim 15 wherein the drive is hydraulically operated.

35. The apparatus for defining a passageway through a composition between first and second spaced locations according to claim 15 further comprising a switch assembly, the switch assembly causing the drive to be disabled automatically as an incident of a mole being advanced to a predetermined position relative to the cable pulling assembly.

36. The apparatus for defining a passageway through a composition between first and second spaced locations according to claim 30 in combination with a cable wherein the cable bears against the cable-engaging part through at least 180° around the first axis.

37. The apparatus for defining a passageway through a composition between first and second spaced locations according to claim 30 in combination with a cable wherein the cable bears against the cable-engaging part through on the order of 270° around the first axis.